A semi-automated method for measuring the evolution of both lumen area and blood flow in carotid from Phase Contrast MRI

Titre	A semi-automated method for measuring the evolution of both lumen area and blood flow in carotid from Phase Contrast MRI
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Résumé en anglais	Phase-Contrast (PC) velocimetry Magnetic Resonance Imaging (MRI) is a useful modality to explore cardiovascular pathologies, but requires the automatic segmentation of vessels and the measurement of both lumen area and blood flow evolutions. In this paper, we propose a semi-automated method for extracting lumen boundaries of the carotid artery and compute both lumen area and blood flow evolutions over the cardiac cycle. This method uses narrow band region-based active contours in order to correctly capture the lumen boundary without being corrupted by surrounding structures. This approach is compared to traditional edge-based active contours, considered in related works, which significantly underestimate lumen area and blood flow. Experiments are performed using both a sequence of a homemade phantom and sequences of 20 real carotids, including a comparison with manual segmentation performed by a radiologist expert. Results obtained on the phantom sequence show that the edge-based approach leads to an underestimate of carotid lumen area and related flows of respectively 18.68% and 4.95%. This appears significantly larger than weak errors obtained using the region-based approach (respectively 2.73% and 1.23%). Benefits appear even better on the real sequences. The edge-based approach leads to underestimates of 40.88% for areas and 13.39% for blood flows, compared to limited errors of 7.41% and 4.6% with our method. Experiments also illustrate the high variability and therefore the lack of reliability of manual segmentation.
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